An Unusual Case of Asphyxia by Ligature about the Thorax

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Compressive asphyxia is generally defined as a type of asphyxia caused by chest or abdominal compression by a heavy object. It has also been reported that it could be caused by external compression caused by ligatures around the chest or abdomen. However, asphyxia caused by ligature around the thorax has not been reported in suicide cases. We present an unusual case of suicide in which the cause of death was attributed to asphyxia caused by a ligature around the thorax. The deceased was a 41-year-old woman who was found dead and suspended by a rope around the thorax from a rooftop railing on the twelfth floor of a building. On postmortem examination, a ‘C’ shaped ligature mark was identified around the thorax, with a pressure mark in the subcutis and focal intramuscular hemorrhages, which were consistent with the ligature mark. The cause of death was determined to be asphyxia due to external compression of the chest in a suspended position.

Key Words: Autopsy; Asphyxia; Forensic medicine; Compressive asphyxia

Introduction

Asphyxia has often been categorized and defined in diverse studies. Hanging is the most prevalent method of suicide due to asphyxia [1], and data from death certificates indicate that it is the most common suicide method in South Korea [2]. A recent analysis of forensic autopsy data further supports this trend, with hanging identified as the most common cause of death among 1,316 suicide cases in 2017, accounting for 398 cases [3]. Although hanging is the more prevalent method, ligature strangulation is also used to commit suicide by asphyxia. Therefore, when a ligature is used for suicidal purposes, it is usually placed around the neck. Asphyxia resulting from external forces applied to the thorax and abdomen is often described using a variety of terms, such as traumatic asphyxia, compressive asphyxia, and mechanical asphyxia, which are frequently used interchangeably, leading to confusion and a lack of clarity in classification. We present a case of suicide caused by a ligature around the thorax. Through a literature review, we aimed to enhance our understanding of asphyxia classifications and shed light on the complexities involved in its fine categorizations.
Case Report

The deceased was a 41-year-old woman who was discovered, suspended by a rope around the thorax from a rooftop railing on the twelfth floor of a building (Fig. 1A). The deceased had no significant medical history, and was not known to have recently consumed tobacco or alcohol. After the loss of her beloved canine companion, the deceased suffered severe emotional distress, which led her to discontinue her professional endeavors, withdraw from family interactions, and develop a tendency to isolate herself from her residence. According to the building’s closed-circuit television data, she got on the elevator alone at approximately 01:00 AM and went to the rooftop unaccompanied. The deceased was discovered 36 hours later. She was clad in heavy clothing with a loop around the thorax (Fig. 1B). The rope was tied to an air-conditioning conduit on a rooftop. The deceased’s posture implied that the rope bore the entire body weight, potentially causing compression.

This case was consulted for postmortem examination two days after the discovery. The body mass index was 14.29 kg/m\(^2\). On external examination, a ‘C’ shaped ligature mark was observed around the thorax, which appeared to be consistent with the loop of the rope. The ligature mark extended from the left flank, rising anteriorly on the chest, and running horizontally on the back. The highest suspension point was located in the right upper flank (Fig. 2). Livor mortis was observed on the lower part of the body such as the lower extremities and around of the left elbow. Petechial hemorrhages were not identified in the conjunctiva (Fig. 3) and congestion was not observed in the head. Focal contusions and superficial abrasions were observed on the elbows and knees. Internal examination revealed a pressure mark in the subcutis, which was consistent with a ligature mark. An intramuscular hemorrhage was also observed in the left thoracic region. There were no significant natural diseases except mild steatosis in the liver. Oil red O staining was performed on the kidney, heart, and liver tissue sections to detect lipid droplets. Although a few lipid droplets were identified in the liver, there was no evidence of fatty degeneration in the renal tubular epithelium or myocardial cells. Ancillary testing, including toxicology and postmortem biochemistry, revealed no significant findings, except for a blood alcohol concentration of 0.027%. Overall, considering the historical circumstances, scene information, and findings arising from the postmortem examination and ancillary studies, the cause of death was attributed to asphyxia caused by external compression of the chest and a suspended position. In addition, hypothermia might have played a contributing role in her death.

Discussion

This case highlights that the pressure applied to the

Fig. 1. (A) The deceased is discovered suspended by a rope around the thorax from a rooftop railing on the twelfth floor of a building. (B) A loop tied around the thorax is observed, which is bearing the deceased’s weight.
chest by the ligature can cause death by compressive asphyxia. The deceased was suspended by a rope around the thorax and a ligature mark consistent with the loop of the rope was observed in the thoracic area. Pressure marks in the subcutis and an intramuscular hemorrhage were identified in the thoracic region. The posture of the deceased and the postmortem findings indicated that her entire body weight was applied to the rope in a vertically suspended position, resulting in death due to a combination of compressive asphyxia and adverse physiological responses associated with the suspended position.

The subcategories and terminology of asphyxia have not been uniformly defined, and various definitions have been used in multiple papers and textbooks. Nevertheless, most studies distinguish between the definitions of traumatic and positional asphyxia. Traumatic asphyxia typically refers to asphyxia resulting from pressure on the chest or abdomen, whereas positional asphyxia refers to a specific body posture that restricts breathing, often because of confinement in limited spaces or positions [4–8]. Sauvageau and Boghossian [7] attempted to reconcile various nonstandardized terms across textbooks. They proposed the term ‘mechanical asphyxia’ to describe the asphyxiation caused by restricted respiratory movements. This term encompasses two types of asphyxia: positional asphyxia, which results from body posture; and traumatic asphyxia, which results from external chest or abdominal compressions. It is generally recognized that traumatic asphyxia occurs when the chest or abdomen is compressed, and positional asphyxia occurs when the body is positioned in a position that impairs breathing [7]. Na et al. [9] introduced a modified asphyxia classification system based on a new classification system developed by Sauvageau and Boghossian. Their classification includes suffocation, strangulation, mechanical asphyxia, and complicated asphyxia. Mechanical asphyxia can be further subdivided into positional and compressive asphyxias. To enhance comprehension and define the mechanism of death more clearly, they suggested using the term ‘compressive asphyxia’ in place of ‘traumatic asphyxia’ [9]. Hence, in this case, the external pressure...
on the thorax without any significant findings that could not potentially be attributed to asphyxia was close to the general definition of compressive asphyxia.

However, given that compressive asphyxia is typically defined as asphyxia caused by ‘heavy objects,’ there is also a question as to whether this case could be considered as compressive asphyxia because the asphyxia was caused by a loop around the thorax through a similar mechanism to that of hanging. Karger et al. [10] reviewed seven reported cases of death due to restraint using a belt or protective cover. Three types of deaths are associated with medical restraint devices: strangulation, mechanical asphyxia from thoracic or abdominal compression, and thoracic or abdominal compression without clear signs of asphyxia. While their study involved elderly individuals with significant preexisting medical conditions, their findings suggested that the pressure of restraint devices exerted on the chest or abdomen can cause death by compressive asphyxia [10]. It is generally understood that strangulation by ligature occurs only when pressure is applied to the neck by the ligature, as in cases of hanging or ligature strangulation. However, both Karger et al. [10] and the present case suggest that compressive asphyxia due to ligature can occur when pressure is applied to the chest or abdominal regions.

In this case, the distinct suspension position of the deceased was likely to have contributed to the death. Suspension trauma, also referred to as harness-induced trauma, is often encountered in occupational medicine and mountaineering. Trauma occurs when a person remains immobile in the head-up position while suspended in a harness. In such positions, the venous return diminishes because of blood accumulation in the lower extremities. This subsequently results in reduced cardiac output and cerebral hypoperfusion, potentially leading to unconsciousness, and if sustained for prolonged periods, death [11–13]. In this case, the deceased may have been suspended vertically for an extended period, which could have led to suspension trauma. Furthermore, the absence of petechial hemorrhage and facial congestion observed in this case may be interpreted as being attributed to blood pooling in the lower limbs, suggesting the possibility of suspension trauma. Given that the deceased was in a suspended position while being simultaneously compressed by the ligature, the cause of death appeared complex. In addition to compressive asphyxia, the suspended position may have contributed to death by inducing adverse effects such as decreased cardiac output or diminished cerebral perfusion.

Crucifixion is a type of positional asphyxia with a posture similar to that observed in this case, and is characterized by a suspended vertical position and extension of the arms. Respiratory movements are impeded by a restricted position at the level of the armpits and support of body weight by the arms [4,5]. While crucifixion is typically associated with outstretched arms causing respiratory impediment, in this case, a notable difference exists as the deceased’s arms were positioned downward instead of being fixed or raised.

In addition, hypothermia might have contributed to the deceased’s death, because the temperature was between 6.3 and 15.9°C during the time interval from when the deceased entered the building until she was discovered dead. However, hemorrhagic erosion in the gastric mucosa, fatty degeneration as evidenced by oil red O staining [14], and elevated ketone levels, which are sometimes observed in cases of hypothermia, were not remarkable.

In summary, we presented an unusual case of asphyxia caused by external compression of the thorax suspended by a rope loop. To the best of our knowledge, there have been no reported cases of ligature strangulation of body parts other than the neck to commit suicide. This case also implies a comprehensive contextual review is necessary to determine the manner of death.

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Conflicts of Interest
No potential conflict of interest relevant to this article was reported.
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